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## ENERGY ABSORPTION STUDIED TO REDUCE AIRCRAFT CRASH FORCES

Energy absorption is a concept that could save lives in airplane crashes.

Americans fly a large number of lightweight, general aviation airplanes. One goal of the National Aeronautics and Space Administration/Federal Aviation Administration aircraft safety research programs is to give occupants a better chance to survive if the plane crashes. An aircraft subflooring strong enough to bear the stresses of flight, yet capable of being crushed to a predetermined level when subjected to crash impact loads, may help save lives.

Since the mid-1970s, NASA and FAA have been studying the crash dynamics of light planes. In 1977, they began an in-depth look at the energy-absorbing characteristics of aircraft subflooring.

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By redesigning the interior floor, researchers hope to reduce the crash forces that can be transmitted to people inside the plane. Other work is aimed at improving the energy absorption characteristics of aircraft seats and restraint systems.

NASA energy-absorbing configurations were first tested in a machine that slowly compressed the subfloor structure. Other test articles were hoisted about 3 meters (9 feet) and dropped. Each subfloor section had mounted to it the equivalent mass of two seats and their occupants. The concept of transforming a 15-centimeter (6-inch) subfloor into a crush zone with collapsible members was proven worthy of advanced testing.

Theory indicates that the energy from a velocity change of 26 kilometers per hour (16 miles per hour) at 25 G's crushing force is the maximum energy a 15-cm (6-in.) subfloor can absorb. Tests of the subfloor sections have proven that these design concepts are on the right track and test floors are getting near the maximum amount of energy absorption possible.

"We didn't know if our subfloors would behave the way we wanted them to," reported NASA's Huey Carden, "but all three of the completely new, advanced concepts performed as we hoped and one of the two minimum-modification concepts performed well. A mini-mod would require only relatively simple modifications to current designs, while the so-called 'advanced' concept is a large design departure."

In future tests, two designs will undergo full-scale plane crashes at the Impact Dynamics Facility at NASA's Langley Research Center, Hampton, Va. One advanced section and one mini-mod section will serve as the passenger area subfloor to compare results.

In these tests, the planes will be swung by cables, pendulum style, from the top of the outdoor gantry onto concrete-pad more than 60 m (200 ft.) below. The cables will be pyrotechnically severed at the last moment and the rocket-assisted planes will freely impact at a forward speed of 120-128 km/hr (75-80 mph).

A airplane seat is capable of absorbing even more crash impact energy than the subfloor, allowing the occupant several inches to come to rest in a crash. An energy-absorbing seat, anchored to a sturdy floor, takes a share of the jolt by "giving," to more-gently lower its occupant toward the floor. Various seat concepts are being considered both at Langley and at the FAA's Civil Air Medical Institute in Oklahoma City.

"Of course, we don't design airplanes," Carden explains, "all we can do is provide the advanced technology -- a data base -- to manufacturers and permit these concepts to work their way into the aircraft structure and save lives. There is a need for it. In 1980, according to a recent report by the National Transportation Safety Board, 1,375 Americans lost their lives in 3,799 general aviation accidents. The Board has reviewed the research program and encouraged its development to improve safety in some of these cases."

The research on crash dynamics is being expanded to jet transports and will complement current NASA/FAA research aimed at enhancing occupant survivability in post-crash fires.

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